



**NOAA**  
**FISHERIES**  
SWFSC

# SWFSC Ichthyoplankton Program: An ecosystem approach towards fisheries conservation and management

SWFSC Ichthyoplankton Laboratory  
Andrew Thompson and William Watson

Presentation 7.1  
July 29, 2013



whipnose



jack mackerel



king-of-the-salmon

## Presentation Goal

Provide an overview of the type of data that is collected, analyzed and processed by the SWFSC Ichthyoplankton laboratory



# Presentation Overview

- I. Introduction
- II. Sampling Equipment
- III. Temporal & Spatial Coverage
- IV. Quality Control/Data Sample Processing/Data Management
- V. Summary/Conclusions

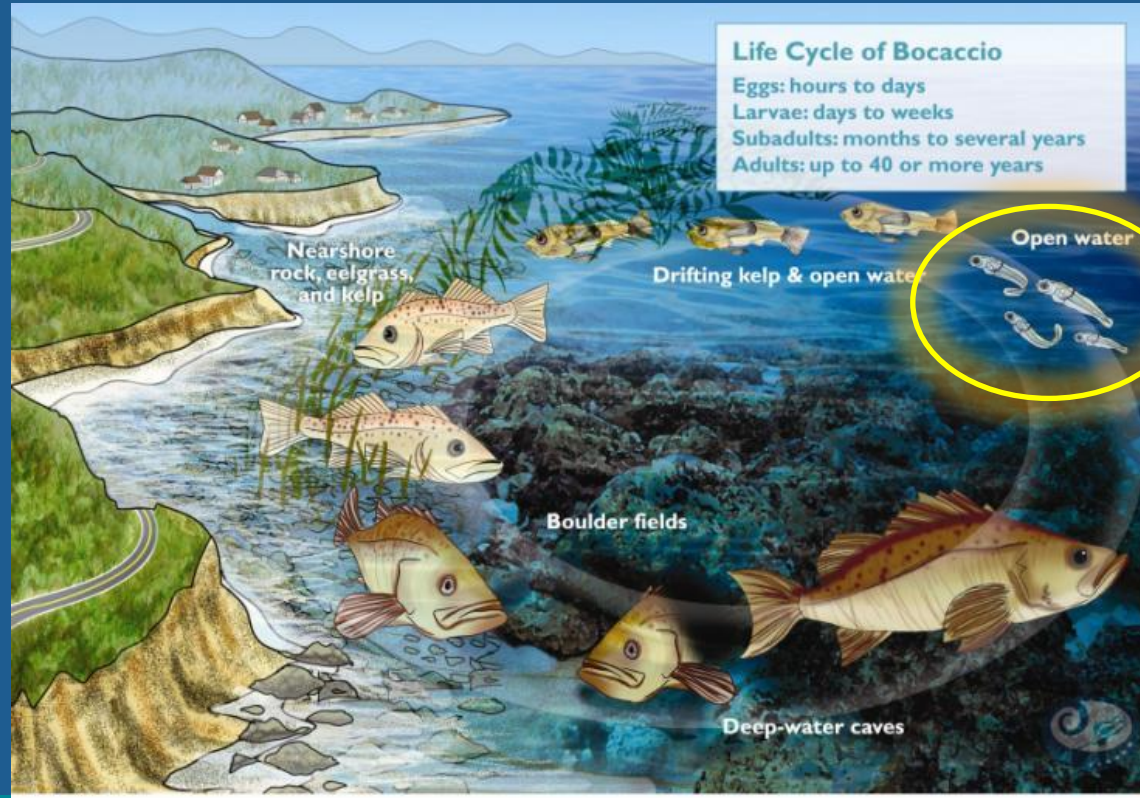


## I. Introduction

Definition of Ichthyoplankton: Pelagic, early life history stage of fishes

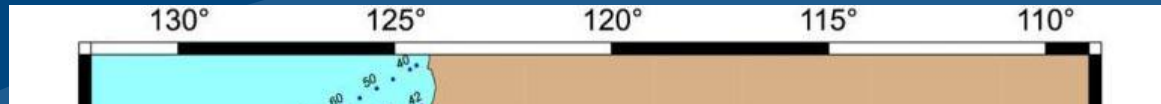
Most fishes (and invertebrates) produce pelagic eggs and/or larvae

Provides information on fishes that reside in many habitats as adults

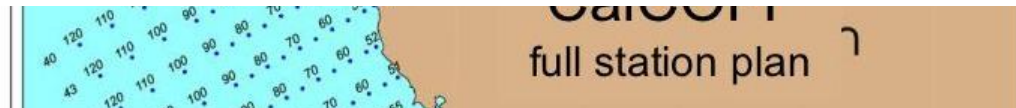




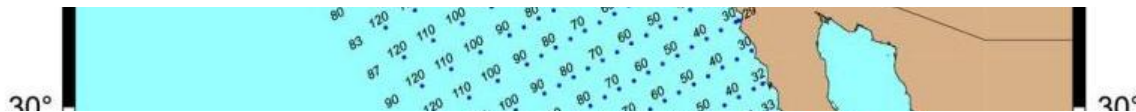
## Brief history of SWFSC ichthyoplankton lab and CalCOFI program



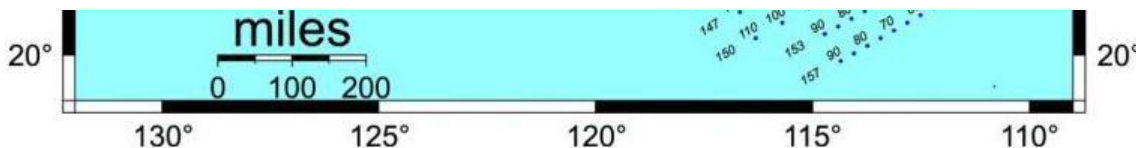
- Began in the 1940's following the collapse of the sardine fishery



- Goals:
  - Use larvae and eggs to evaluate sardine status
  - 1<sup>st</sup> director of SWFSC, Ehlbert Ahlstrom: Identify all fish larvae in CalCOFI region
  - Determine processes affecting spatial and temporal trends in larval distribution and abundance



- Major research breakthroughs:
  - Standardized larval sampling methodology
  - Egg production methods to estimate spawning stock biomass
  - Description of the early life history stages of 586 California Current fish species
  - > 60 years of species-specific distribution and abundance data



## Ichthyoplankton and assessments

### SWFSC Ichthyoplankton data used in stock and ecosystem assessments

#### Past

Anchovy Daily  
Egg Production  
Method (DEPM)

Bocaccio rockfish  
Cowcod rockfish  
Shortbelly rockfish

#### Present

Sardine DEPM

NMFS Integrated  
Ecosystem Assessment



#### Future

Pacific Sanddab  
Dover Sole  
Various rockfishes

## II. Sampling Equipment

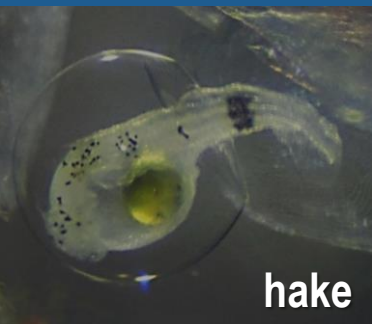
Four primary types of sea-going survey equipment:

Continuous Underway Fish Egg Sampler (CUFES)

Manta net

Bongo net

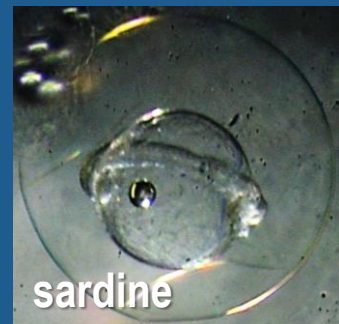
Pairovet (aka Calvet) net



**hake**



**turbot flatfish**



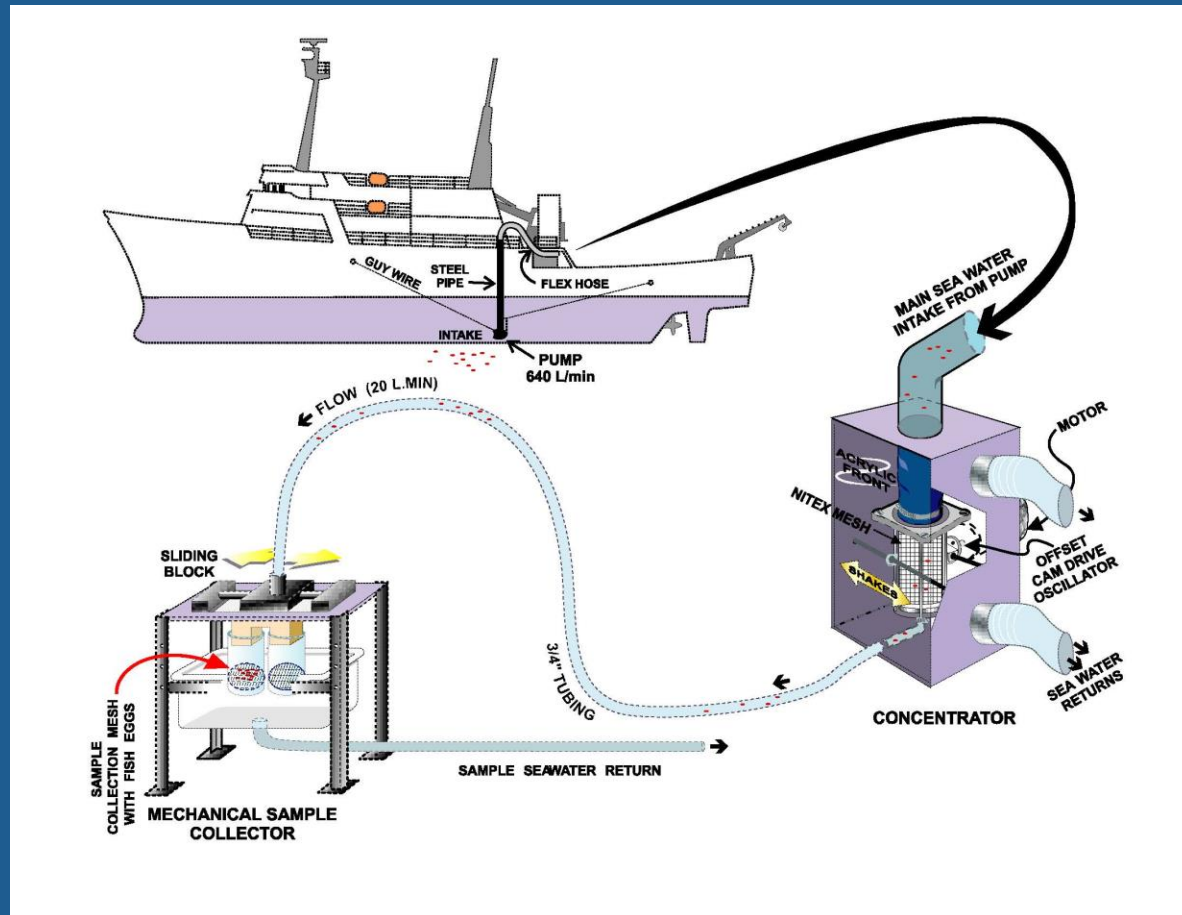
**sardine**



## II. Sampling Equipment

### Continuous Underway Fish Egg Sampler (CUFES)

- Samples continuously from ~ 3 m below surface
  - Samples collected at ~ 30 min intervals
- Allows near real-time observation of near-surface eggs and larvae





## II. Sampling Equipment

### Manta Net

- Surface (nektonic) net tow, .505 mm mesh
- Towed from side of ship for 15 min at a speed of 1 m/s
- Samples preserved in formalin and analyzed in lab



## II. Sampling Equipment

### Bongo Net

- Oblique (45°) tow from 212 m to surface
- Paired samples, 71-cm diameter opening, .505 mm mesh
- Starboard side preserved in formalin; port side in ethanol; analyzed in lab

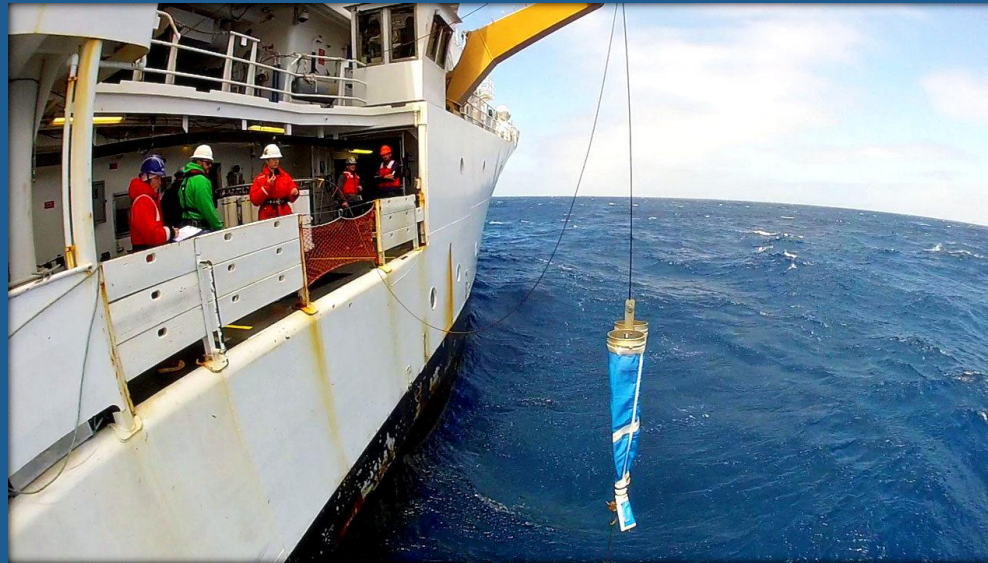




## II. Sampling Equipment

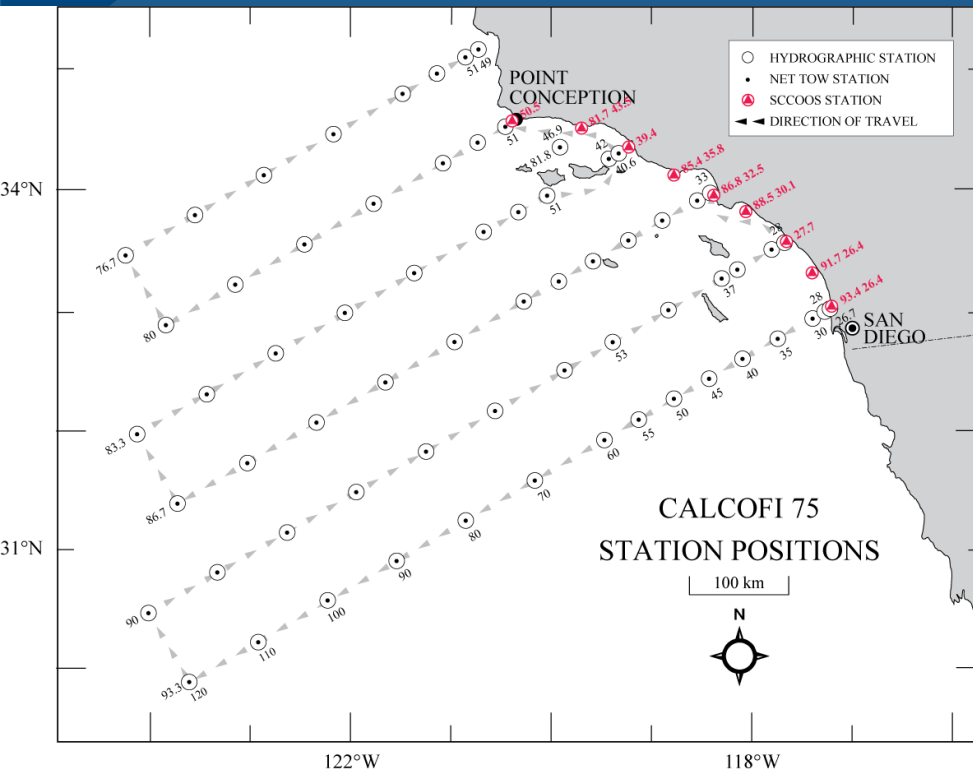
### Paironet (aka CalVET) Net

- Vertical tow from 70 m to surface
- “Mini bongo net”; 25 cm diameter, .150 mm mesh
- Starboard side preserved in formalin; port side not collected; analyzed in lab



### III. Temporal and Spatial Coverage

- Varies by cruise type (e.g., CalCOFI, Spring Sardine, summer SaKe)
  - CalCOFI
- 66 standard CalCOFI (1951-present) + 9 coastal stations (2004-present)
  - Quarterly sampling



#### CUFES

- operates continuously
- samples collected every ~30 min

#### Pairovet

- collected at each fixed station since 1982

#### Bongo

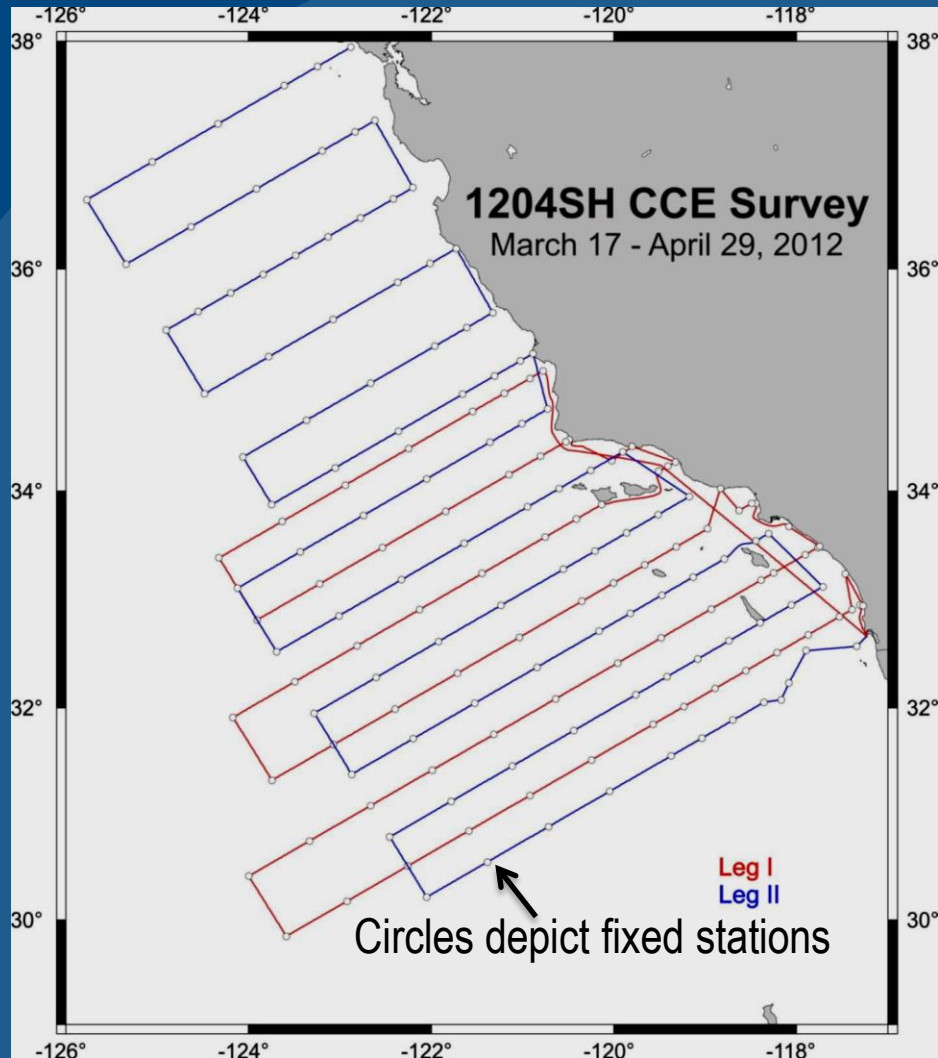
- collected at each fixed station since 1977
- ring net prior to 1977
- port side in ethanol since 1997

#### Manta

- collected at each fixed station since 1981

### III. Temporal and Spatial Coverage

- Spring Sardine
- 75 CalCOFI stations, additional fixed stations, adaptive stations



#### CUFES

- operates continuously
- samples examined every 30 min
- triggers adaptive sampling if  $>1$  egg/min

#### Data used for sardine DEPM

##### Paironet

- collected at each fixed station
- every 4 n miles during adaptive sampling

##### Bongo

- collected at each fixed station

##### Manta

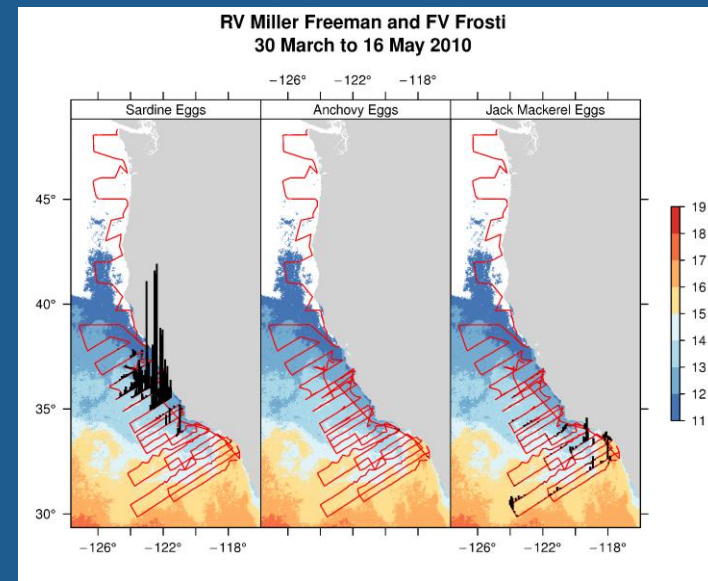
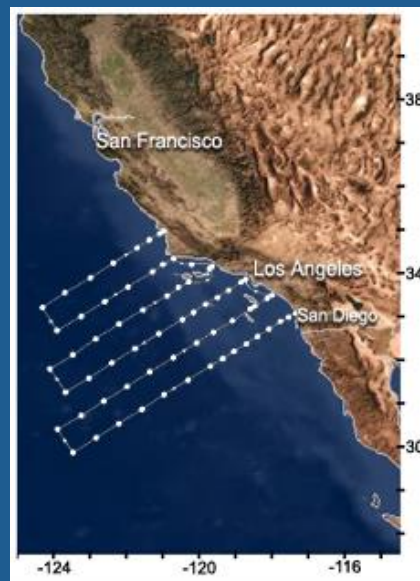
- collected at each fixed station



## IV. Quality Control/Processing/Data Management

### Quality Control

- Sampling Methodology
  - All gear, collection and processing methodologies described in peer-reviewed literature and NOAA Tech Memos
  - Techniques developed at SWFSC are utilized worldwide

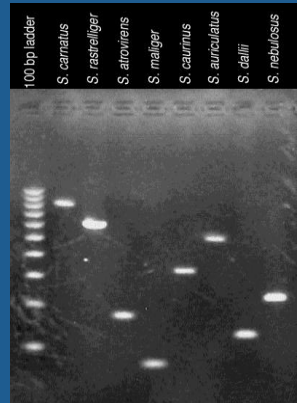


## IV. Quality Control/Processing/Data Management

### Processing

- CUFES samples
  - initially analyzed at sea (to guide adaptive sampling of sardines), preserved in formalin, and entered into database
  - samples with high egg numbers or plankton volume are recounted in lab
- Formalin-preserved Bongo samples
  - in lab zooplankton displacement volumes measured; large samples subsampled
  - Sorting: fish eggs, fish larvae and cephalopod paralarvae removed
  - ID: fish larvae identified and developmental stage determined
  - body length measured for key CPS larvae
- Ethanol-preserved Bongo samples
  - genetics used to ID ambiguous eggs and larvae (rockfishes)
- Pairovet samples
  - entire sample sorted and identified
  - stage of sardine eggs determined
- Manta samples
  - entire sample sorted and identified

black  
eye  
goby



## IV. Quality Control/Processing/Data Management

### Processing

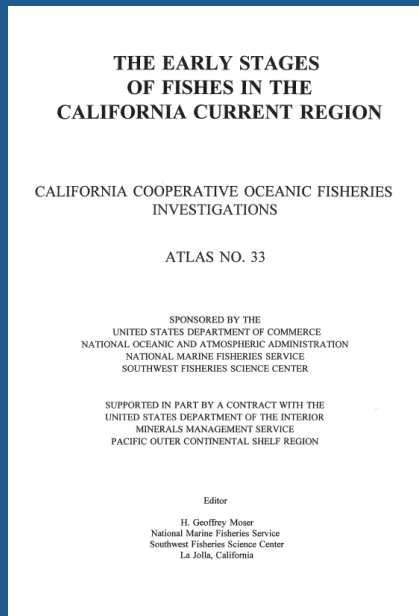
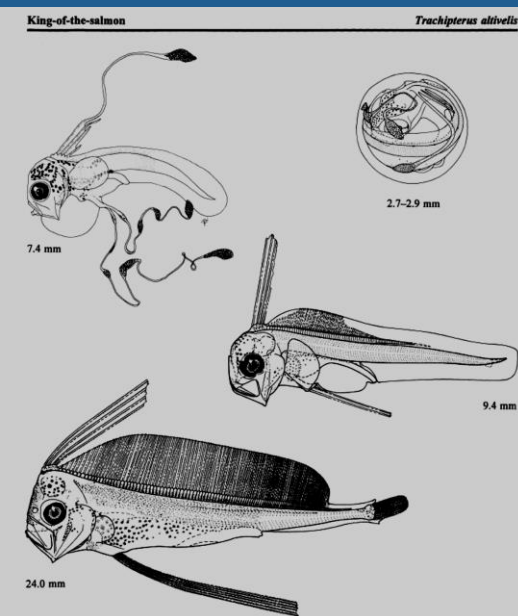
- All samples archived and periodically curated; archived samples date back to 1930's
- Allows for reanalysis of old samples





### Quality Control

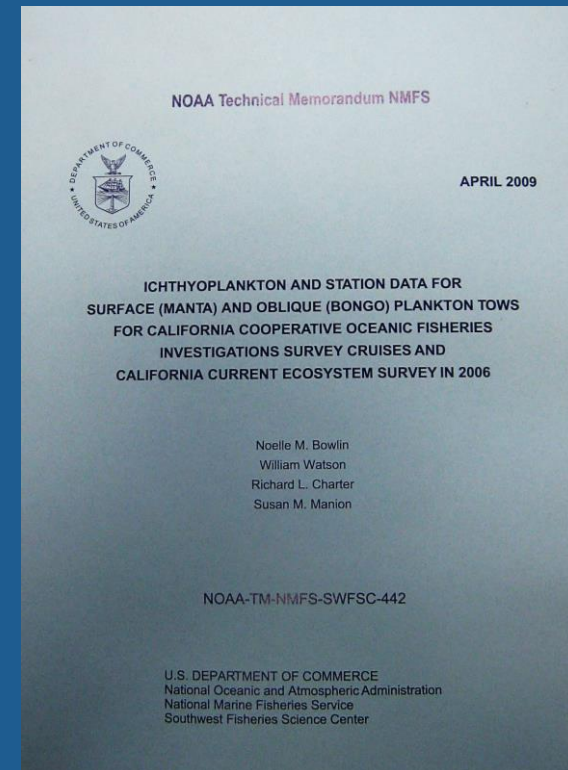
- Sampling Processing
  - Recheck 10% of sorted samples to ensure that > 90% of ichthyoplankton removed
  - Sample identification based on published literature and cross-checking between experts



## IV. Quality Control/Processing/Data Management

### Data Management

- All IDs recorded on data sheets
- Data sheets archived
- Entered into database
- Entries checked against data sheets
- Information published in annual data reports





## IV. Summary

- SWFSC Ichthyoplankton program has been “acquiring knowledge and information ...on fishery conservation and management”\* since the 1940s

- Utilize “ecosystem principles”\*

- Used for many stock assessments; potential for emerging species and Integrated Ecosystem Analysis

- 4 primary collection methods: CUFES, Manta, Bongo, and Pairovet

- Quarterly CalCOFI sampling, Spring coast-wide sardine survey

- Most larvae identified based on morphology; genetic tools used for some taxa

- Data checked and entered into database

\* = quote from **Magnuson-Stevens Fishery Conservation and Management Act**



## IV. Conclusions

### Strengths

- One of the longest marine time-series in world
- Utilized for multiple species
- Potential for different species in the future

### Challenges

- Need to improve tracking of sample processing
- Funding for genetics work – develop time-series for rockfish larvae
- Short staffed, particularly at sorting stage

### Strategies for Improvement

- Creating a new system to track sample processing
- Applying for external funding (e.g., FATE)
- Ensure that permanent position are refilled and contract positions are created for 3 sorters



# SWFSC Ichthyoplankton Research in support of the MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

## Title IV, Sec. 404

(a) IN GENERAL.-- “The Secretary shall ... maintain ...a comprehensive program of fishery research .... Such program shall be designed to acquire knowledge and information ...on fishery conservation and management”

(c) AREAS OF RESEARCH (1) “Research to support fishery conservation and management, including but not limited to, biological research concerning the abundance and life history parameters of stocks of fish, the interdependence of fisheries or stocks of fish, the identification of essential fish habitat ... and other factors affecting the abundance and availability of fish”

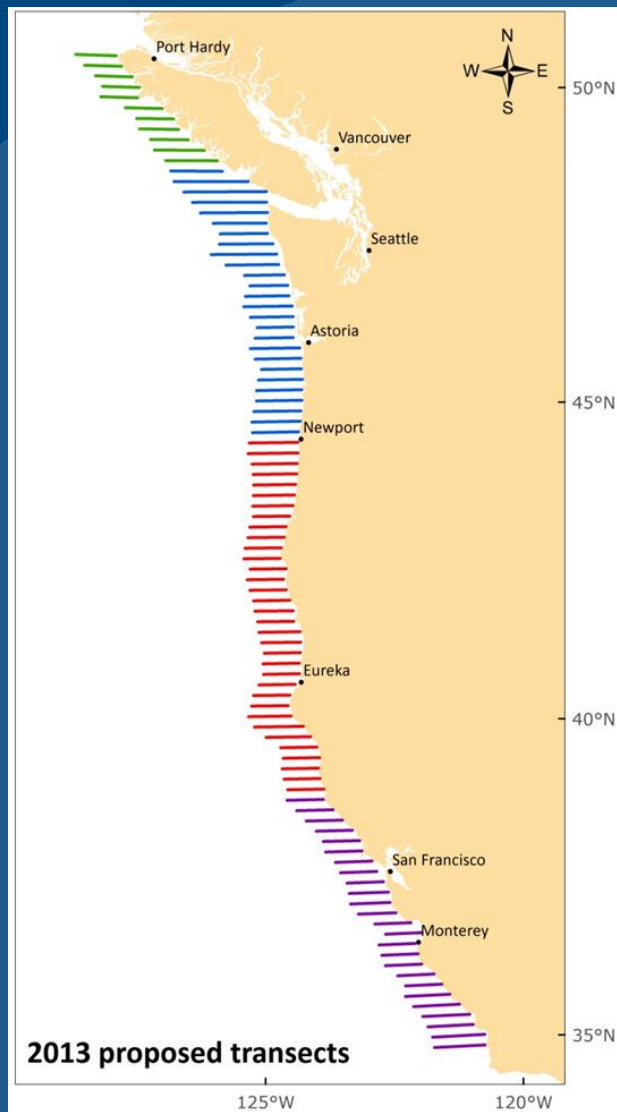
## Title IV, Sec. 406

(a) “the Secretary shall expand the application of ecosystem principles in fishery conservation and management activities”



### III. Temporal and Spatial Coverage

- SaKe
- 94 transects over continental shelf



#### CUFES

- operates continuously
- samples examined every 30 min

#### Paironet

- collected once per night

#### Bongo

- collected once per night

#### Manta

- not used